Aircraft radar station TsD-ZOT

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The station anti-jamming device includes the following units:

· Block of protection against asynchronous impulse interference (block 25)., Providing protection against interference and synchronization of the station.

· Synchronizer (block 36), which issues trigger pulses to the transmitter and receiver.

· Receiver (block 38), subject to protection from synchronous impulse interference from distant targets.

· Junction box (block 42), providing circuit switching of the protection unit.

The functional diagram of the device is shown in Fig. five.

Synchronization of the station operation is ensured by a strict sequence of triggering pulses, the repetition rate of which is determined by the ultrasonic delay line (UZLZ). The magnitude of the delay of the UZLZ is equal to T μsec.

From a self-excited blocking generator 25L14, (having its own repetition rate of about 1500 Hz), a negative pulse with a duration of 10-20 μs is fed to the grid of the 25L4-3 modulator, which controls the 25L4-4 exciter. An exciter pulse with a frequency of 10 MHz excites quartz, built at 10 MHz, in the USLZ. Quartz converts electrical vibrations into mechanical ones, which are delayed in the delay line.

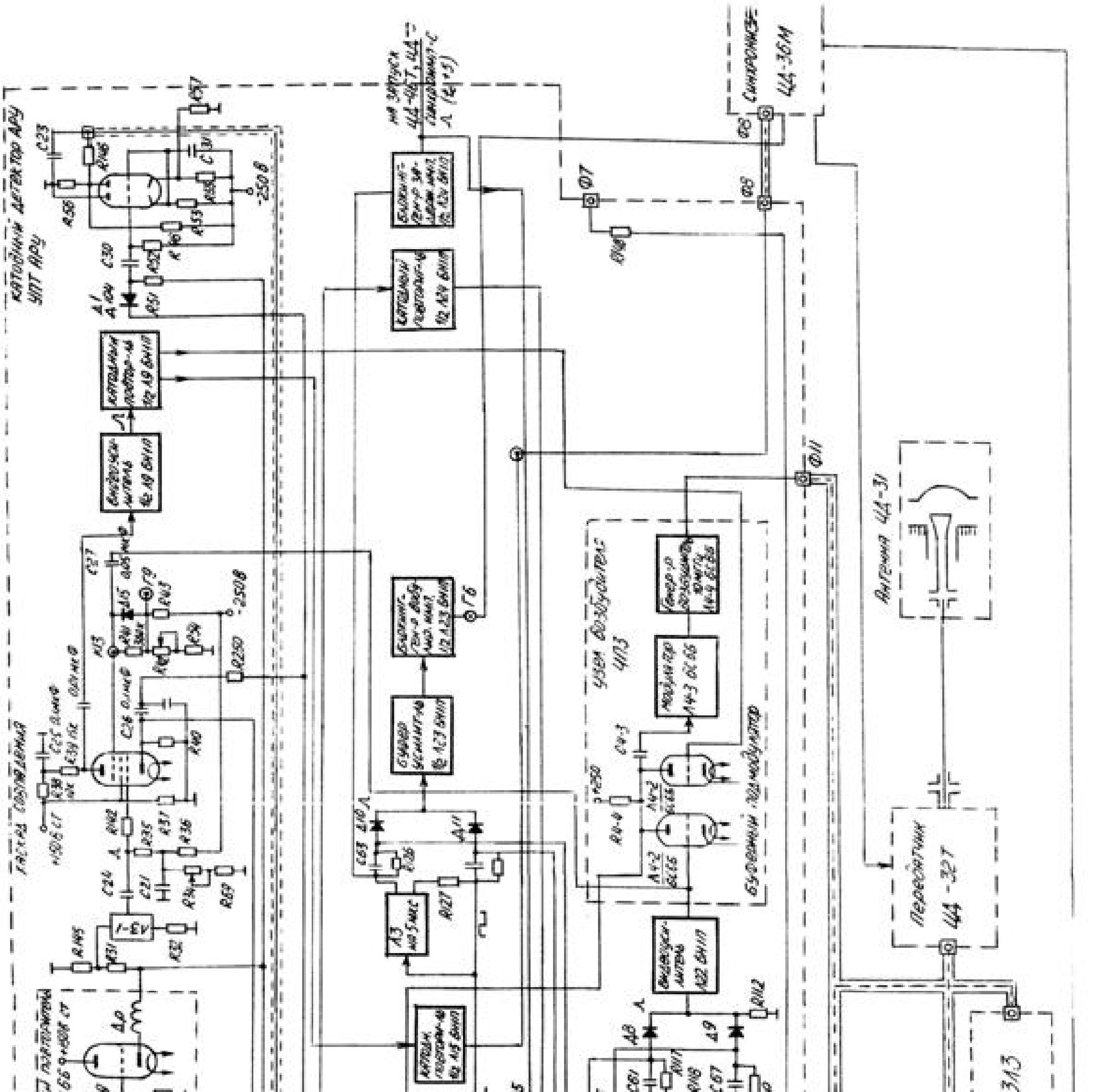

РИС 5 Функциональная схема блока защиты

At the output of the UZLZ there is also a second quartz tuned to a frequency of 10 MHz, which converts mechanical vibrations into electrical ones. Weak electrical vibrations from the second quartz of the UZLZ enter the UPCH-10, where they are amplified by the lamps 25L5-1 - 25L5-5 and D5-1 are detected.

The detected video pulse is amplified by a video amplifier 25 L5-6 and through the cathode follower 25L5-7 is fed to the starting lamp of the self-excited blocking generator 25L14, synchronizing the latter. Thus, the master blocking generator 25L14 will self-synchronize with a delay determined by the UZLZ.

This method of operation of the master blocking generator leads to high stability of the repetition period (T) of sync pulses.

Station protection from asynchronous impulse noise is provided by a special protection circuit, which includes:

· The 25L8 coincidence circuit, which ensures the transmission of video pulses only if the target video pulses, delayed for the repetition period and not delayed, coincide.

· A delay circuit that provides a video pulse delay for the pulse repetition period.

· An integration circuit that provides an increase in the amplitude of the video signal.

The principle of operation of the protection circuit is carried out due to the coincidence of the target impulses delayed for the repetition period and not delayed and is explained by the timing diagram shown in Fig. 6.

The target video pulse from the output of the receiver through the cathode follower 1/2 25L13 is fed to the input of the devobulator, from the output of which it is fed to the grid of the 25L22 amplifier. The amplified video pulses are fed to the pentode grid of the 25L8 coincidence stage and to the amplifier of the 4PZ 25L4-2 unit.

Further, the target pulse, as well as the previously described synchronization pulse, passes the modulator, exciter, UZL and UPCH-10.

The target pulse detected and amplified in the 25L5-6 video amplifier through the 25L5-7 cathode follower and the correcting delay line for 0.1 μsec (25-LZ-1) are fed to the control grid of the 25L8 coincidence cascade. Simultaneously with the delayed UZL8 target pulse, the next video pulse of the target is fed to the coincidence stage on the pentode grid.

As a result of the coincidence in time of the target video pulses on the two grids, a target pulse appears at the output of the coincidence circuit, which is amplified by 1/2 25L9 and is fed to the input of the protection unit through the cathode repeaters 1/2 25 L9 and 1/2 25L15. An amplified pulse of coincidence with 25L9 is also fed to the amplifier of the 4NZ L4-1 unit, where, in addition to the pulse of the L4-2 video amplifier of the not delayed path, they affect the modulator and the exciter.

As a result of this addition, at the output of the coincidence circuit, there is an increase in the signal amplitude from pulse to pulse - the effect of integration.

Asynchronous interference pulses, the repetition period of which differs from the repetition frequency of the station, but coincide in time on the grids of the coincidence stage and do not pass through the coincidence stage circuit.

The probability of coincidence of the noise pulses decreases due to their randomness and the presence of a cutoff on the control grid of the 25L8 coincidence stage lamp.

Due to the cutoff of the coincidence lamp on the control grid, the signal integration starts from a certain threshold, and a significant increase in the signal-to-noise ratio is observed at the output of the coincidence circuit.

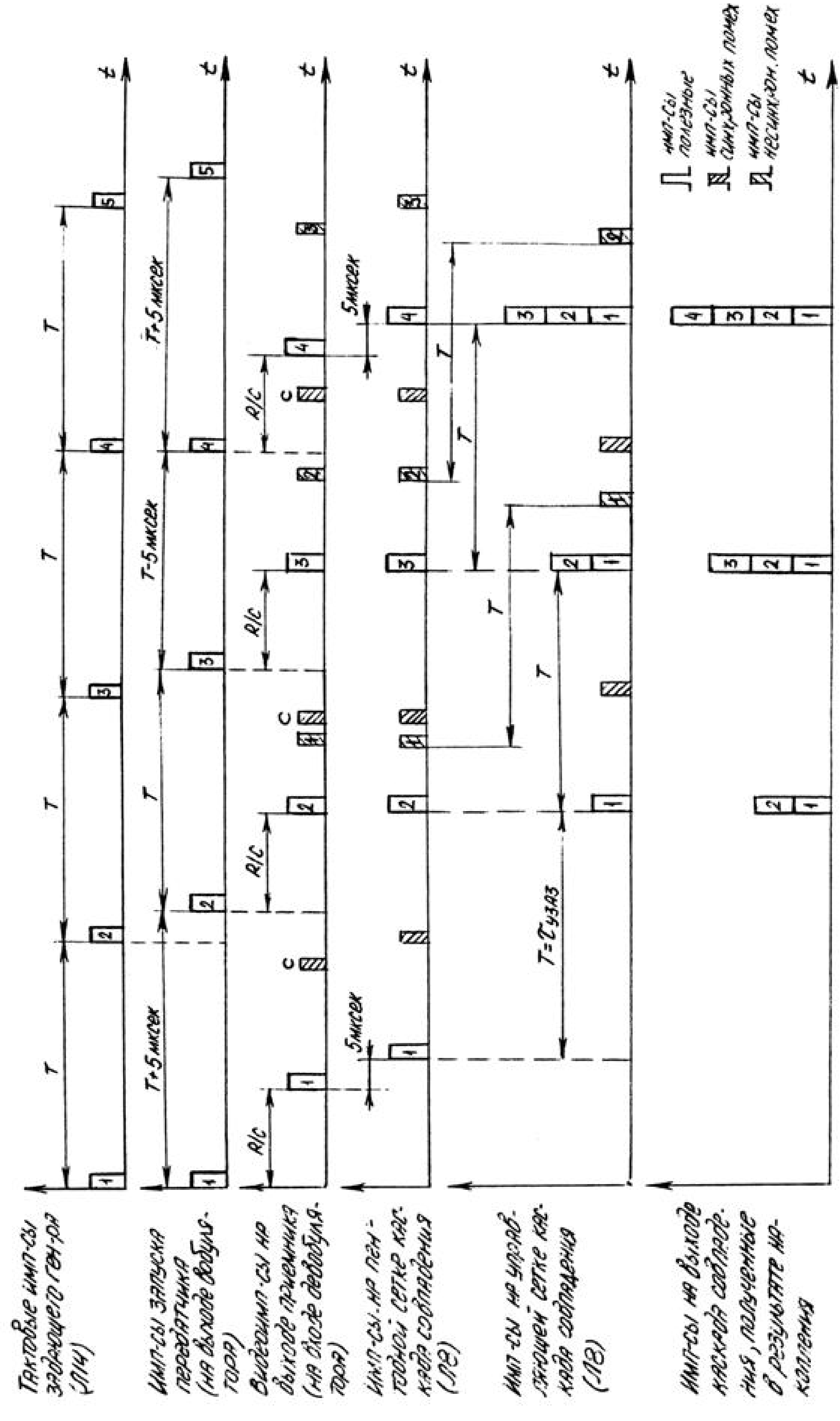

Рис. 6 Временные диаграммы

Due to the presence of feedback in the protection circuit / integration /, the loss in sensitivity on the coincidence stage is compensated for due to cutoff.

Protection of the radar path from synchronous impulse noise coming from its own sounding pulses and falling into the second and third periods of the station's operation is ensured by wobbling (modulating in time) of the sounding pulses.

To ensure the correct operation of the protection unit in the first period of the station operation, the devobulation of the reflected wobbled pulses from the target was applied.

The trailing edge of the master blocking generator 25L14 starts the blocking generator 1/2 25L15, the pulse from which directly, or delayed by 5 μs by the wobbler delay line, is fed to the start of the next blocking generator 25L23. A pulse from the cathode load of the 25L23 blocking generator is issued to start the synchronizer, from which the transmitter is started.

The video pulse of the target arriving from the output of the TsD-33 receiver to the TsD-25T protection unit through the cathode follower 1/2 P3 directly, or delayed by 5 μs by the de-wobulator delay line, is fed to the 25L22 amplifier, from which it is fed to the coincidence stage and through the amplifier 25L4-2 node 4P3 per modulator.

The wobbler and the devobulator are switched by a special switching pulse from the switch circuit. Moreover, wobbling and devobulation are phased in such a way that when the transmitter start pulse is not delayed at the first clock cycle, then the target pulse of the first clock cycle goes to the coincidence stage with a delay and vice versa, at the 2nd and 3rd clock cycles the transmitter startup pulse is delayed, and through the devobulator the target's impulse passes unrestrained.

The switching of the delay of the video pulse of the target and the trigger pulse is carried out by the 25L20 trigger circuit, which is triggered along one grid with a period of T by the pulses of the master blocking generator, and along the other grid by the pulses of the blocking generator, the frequency "1: 3" (I / 2 25L13) is divided with a period 3T.

With such a switching of the trigger pulse and the target video pulses, we obtain the simultaneous arrival at the cascade of the coincidence of the target pulse from the 25P22 video amplifier and the target pulse that came through the UZLZ. Such coincidences will exist with the arrival of reflected target pulses during the first period of the station operation. When the reflected pulses of the target arrive at the second and third periods of the station operation from the probing pulses of the first period of the simultaneous arrival of the delayed UZPZ and non-delayed pulses on the 25L8 coincidence cascade will not exist. Such reflected pulses will not pass through the coincidence stage and thus will not reach the indicator device.

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